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This report describes progress under Naval Air Systems Command Contract N00019-79-C-0291 during the final quarterly period. Research on adaptive arrays for communication applications is summarized.

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I. INTRODUCTION

This report describes progress under NASC Contract N00019-79-C-0291 during the last quarterly period. There are three areas of work under this contract. The first involves studies on weight jitter and dynamic range for the improved LMS loop. The second is a continuation of research on a reference signal generation technique for FSK signals. The third area involves the preparation of a monograph on adaptive arrays.

II. PROGRESS

(1) The Improved LMS Loop

During the final quarter, studies on the dynamic range of the improved LMS loop [1] have been completed. These studies have concentrated on the effect of finite multiplier dynamic range on loop performance. The eigenvalues of the system have been calculated under various conditions of multiplier saturation. In general, one finds that a departure from linearity in either the direct signal path or the extra feedback path causes the eigenvalues to become spread again. The resulting time constant spread depends on saturation levels, gain constants, noise power, etc. These results give us a good idea of the problems to be encountered when a loop of this type is implemented.

(2) Reference Signal Generation with FSK Signals

In this last quarter, our studies on the use of adaptive arrays with binary FSK signals have also been completed. Our most recent work has concerned the lockup behavior of the reference signal loop and the array in the presence of CW interference. The simulations show that the array locks up well.

Specifically, we have studied the lockup behavior of the system as a function of the desired signal bit prediction probability and as

a function of the interference frequency and power. It is found that prediction probabilities of about 0.7 are necessary for reliable lockup. As long as the prediction probability is at least 0.7, the array acquires the desired signal properly regardless of interference power and frequency. (However, the interference power affects the lockup time, because it affects the adaptation speed of the LMS loops. Also, the worst frequency for the interference is halfway between the two FSK frequencies. In this case the reference loop has the smallest processing gain against the interference. Nevertheless, the system appears to lock reliably even with the interference at this frequency.)

A technical report containing these results is in preparation and will be published soon.

(3) <u>The Adaptive Array Monograph</u>

We have made considerable progress on the monograph during the last quarter. At this writing, 335 pages of text have been completed. (These are double-spaced typewritten pages interspersed with figures. We estimate that this material will occupy half as many pages in book form.) It now appears that the completed manuscript will be between 400 and 500 pages long. We expect to complete this material during the first quarter of the continuation contract. The entire manuscript will need one more editing and then will be ready for submission to a publisher.

III. PAPERS PUBLISHED

During the current year, three papers have appeared that were submitted during the previous contract (N00019-78-C-0131):

(1) W. E. Rodgers and R. T. Compton, Jr., "Adaptive Array Bandwidth with Tapped Delay-Line Processing," IEEE Transactions on Aerospace and Electronic Systems, Vol. AES-15, No. 1 (January 1979), p. 21.

(2) R. T. Compton, Jr., "The Power Inversion Adaptive Array--Concept and Performance," IEEE Transactions on Aerospace and Electronic Systems, Vol. AES-15, No. 6 (November 1979), p. 803.

(3) R. T. Compton, Jr., "Power Optimization in Adaptive Arrays: A Technique for Interference Protection," IEEE Transactions on Antennas and Propagation, Vol. AP-28, No. 1 (January 1980), p. 79.

In addition, one other paper submitted during the previous contract will appear soon:

(4) R. T. Compton, Jr., "An Improved Feedback Loop for Adaptive Arrays," IEEE Transactions on Aerospace and Electronic Systems, Vol. AES-16, No. 2 (March 1980), p. 159.

During the present contract (N00019-79-C-0291), five new papers have been submitted for publication:

(5) R. T. Compton, Jr., "Pointing Accuracy and Dynamic Range in a Steered-Beam Adaptive Array," accepted for publication in IEEE Transactions on Aerospace and Electronic Systems, Vol. AES-16, No. 3 (May 1980).

(6) A. Ishide and R. T. Compton, Jr., "On Grating Nulls in Adaptive Arrays," accepted for publication in IEEE Transactions on Antennas and Propagation, Vol. AP-28, No. 4 (July 1980).

(7) R. T. Compton, Jr., "On the Performance of a Polarization Sensitive Adaptive Array," submitted to IEEE Transactions on Antennas and Propagation.

(8) R. T. Compton, Jr., "The Tripole Antenna--An Adaptive Array with Full Polarization Flexibility," submitted to IEEE

Transactions on Antennas and Propagation.

(9) R. T. Compton, Jr., "The Effect of Differential Time Delays in the LMS Feedback Loop," submitted to IEEE Transactions on Aerospace and Electronic Systems.

IV. REFERENCES

1. R. T. Compton, Jr., "An Improved Feedback Loop for Adaptive Arrays," Report 710929-3, July 1978, The Ohio State University ElectroScience Laboratory, Columbus, Ohio; prepared under Contract N00019-78-C-0131 between Naval Air Systems Command and The Ohio State University Research Foundation.